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(54)[TITLE OF THE INVENTION] MIG welding or the MAG welding method, and its apparatus

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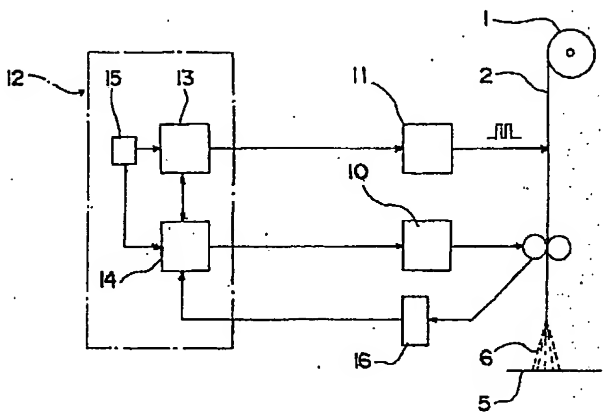
(57)[ABSTRACT OF THE DISCLOSURE]
[SUBJECT OF THE INVENTION] MIG welding which forms weld zone efficiently and rapidly or the MAG welding method, and provision of the apparatus.

[PROBLEM TO BE SOLVED] Pulse-like electric current is supplied to electrode wire 2 so that arc 6 between electrode wires 2 and zone to be welded 5 to supply may be maintained.
Also, electric-current value is set as level which one droplet generates for every pulse, coarseness and minuteness of the pulse interval is changed periodically.
Furthermore, supply speed of electrode wire 2 is proportioned in pulse density.



[CLAIMS]
[CLAIM 1] In MIG welding which supplies pulse-like electric current to this electrode wire 2, and welds welded body 5 so that arc 6 between electrode wires 2 and welded bodies 5 to supply may be maintained, or the MAG welding method, as value in which one droplet generates electric current for every pulse, coarseness and minuteness of the pulse interval is changed periodically.
Supply speed of electrode wire 2 is proportioned in this pulse density.
MIG welding characterized by the above-mentioned, or the MAG welding method.

[CLAIM 2] In MIG welding which supplies pulse-like electric current to this electrode wire 2, and welds welded body 5 so that arc 6 between electrode wires 2 and welded bodies 5 to supply may be maintained, or MAG welding apparatus, supply apparatus 10 of electrode wire 2, electric-current supply apparatus 11 to electrode wire 2, while controlling electric-current supply apparatus 11 to change periodically coarseness and minuteness of pulse interval of electric current, control device 12 which controls supply apparatus 10

so that supply speed is proportional to the pulse density, are provided.
MIG welding characterized by the above-mentioned, or MAG welding apparatus.

[DETAILED DESCRIPTION OF THE INVENTION]
[0001]
[TECHNICAL FIELD OF THE INVENTION] This invention supplies pulse-like electric current to this electrode wire so that arc between electrode wires and welded bodies to supply may be maintained, flaky beat is formed and welded to weld.
It is related with MIG welding characterized by the above-mentioned or the MAG welding method, and its apparatus.

[0002]
[PRIOR ART] Formerly, like welding between terminal portions of metallic conduit, when whole circumference of the comparison section needs to be welded, electrode has TIG welding, MIG (metal inert gas) welding, or MAG (metal active gas) welding to supply pulse current.
The former TIG welding has welding rod of electrode, and it and another body, it is the method of welding, while laping both in the same direction.
Since the amount of welding of one time is small, there is disadvantage which weld time gets long.
This welding supplies pulse current to electrode, after base material is melted and then while melting electrode, welding operation is performed.
In this welding, pulse current controls heat gain to base material by adjusting the spacing, it tries to perform optimal welding.

[0003] Next, the latter MIG welding and MAG welding have the large amount of welding of one time compared with said TIG welding.
Pulse current in this case does not stop only at controlling heat gain with respect to base material, but discharges droplet from front end of electrode.
That is, with supply of pulse current, electromagnetic force points molten metal at the front end of electrode to base material by role and the so-called pinch effect, and discharges at the front end of electrode.
Maximum value of the pulse current and waveform are set up so that pinch effect may be demonstrated enough.
In addition, MAG welding differs in the shielding gas from it of MIG welding.
Others are substantially the same.
Then, both are summarized and it demonstrates as the MAG welding method.

[0004] FIG. 8 is apparatus block diagram for demonstrating principle of the conventional MAG welding method.
Weld zone supplies electrode wire 2 which coiling roll 1 wound in FIG. 8 at fixed speed with supply apparatus 3 which has a pair of driving roller.
Pulse-like electric current is supplied to electrode wire 2 to supply from electric-current supply apparatus 4, while arc 6 is formed in weld of welded body 5 of it,

droplet is discharged to base material from electrode front end.
Setup of speed of these supply apparatus 3, electric-current control of electric-current supply apparatus 4, etc. are performed by control device 7.
In addition, gas-shield part is omitted for convenience and FIG. 8 shows it.
With such MAG welding, in order to weld whole circumference of pipe, edge preparation is beforehand performed to comparison section of pipe, from lower end of the pipe, electrode is transferred to upper direction and it welds to every one side, bad influence by dripping of molten metal needed to be eliminated.
In that case, welding sagging had to weld whole circumference of pipe by welding condition of pipe bottom which poses problem.
At this time, frequency of welding pulse of welding condition is made comparatively less, heat input of welding per predetermined time had to be made small.
Then, welding efficiency falls.

[0005] Next, also when MAG welding of the plane comparison part was carried out, edge preparation is usually beforehand performed to base material of weld zone.
When electrode is linearly transferred along valley bottom of open end at this time, in zigzag form of undulation to valley bottom of open end, electrode may be moved.
Anyway, when supplying pulse current to electrode at fixed spacing, if the pulse interval is too short, heat gain will increase, there is a possibility of molten metal draining out from valley bottom of open end to undersurface side, and causing poor welding.
Moreover, if spacing of pulse current is too long, heat gain will become smaller, it becomes lack of penetration of base material, and there is a possibility that reliability of welding may be missing.
So, it was very troublesome to have set up the optimal pulse interval, and it was what requires experience.

[0006] Moreover, even if it set up the optimal possible pulse interval, case where penetration width and depth of penetration of open-end section were not enough often existed.
By slight change of pulse interval, penetration became insufficient.
It is because melting too much of base material may happenp419x3224Y
In the case of narrow edge as for which open-end width becomes very narrow in particular, that appears notably.
This is because electrode must be linearly transferred along valley bottom of open end.
In addition, long and short of the above-mentioned pulse interval appears as a result considering waveform of each pulse, and maximum value as fixed, then a power supply per unit time, it becomes heat gain per unit time.
Moreover, this can also be caught with effective current per unit time, or average electric current.

[0007]
[PROBLEM TO BE SOLVED BY THE INVENTION] It was very difficult to perform control of welding pulse, securing rapidness of welding operation, and reliability of weld zone by the above-mentioned conventional MAG welding method.
Then, this invention makes it subject to solve problem in such a conventional MAG welding method.

[0008]
[MEANS TO SOLVE THE PROBLEM] That is, invention of Claim 1 is MIG welding which supplies pulse-like electric current to this electrode wire, and welds welded body so that arc between electrode wires and welded bodies to supply may be maintained, or the MAG welding method.
And this method changes coarseness and minuteness of that pulse interval periodically as a value in which one droplet generates electric current for every pulse.
Supply speed of electrode wire is proportioned in this pulse density.
It is characterized by the above-mentioned.

[0009] According to the above-mentioned method, droplet with coarseness and minuteness supplied to weld zone is continuously supplied, and since it is made to supply speed of electrode wire to be proportional to the exhaustion speed, periodic enlargement reduction of molten-metal pool can be performed smoothly, and dripping from molten-metal pool is inhibited by it.
It is because movement of heat to running direction of welding can be blocked as much as possible while this limits heat input by period with sparse pulse interval while it can enlarge heat gain by period with dense pulse interval and can take large melted width and large melted depth of base material, and it makes the liquidity of molten metal small.
Thereby, penetration width and depth of base material can prevent dripping of molten metal greatly.
Therefore, whole circumference of piping welding can be welded in the fixed direction, and welding can be performed rapidly.
And dripping is inhibited.
Therefore, while pulse can increase welding current of dense area
Since amount of supply of wire can be increased, the amount of welding of one time increases as a whole, welding can be rapidly performed also from the point.
Moreover, when heat gain of welding is made the same as conventional it, while being able to supply more major welding current, wire amount of supply can be increased in this invention dense pulse area.
Therefore, penetration width and depth of penetration of welding can be enlarged.
Thereby, reliability of welding improves.

[0010] Moreover, invention of Claim 2 is MIG welding which supplies pulse-like electric current to this electrode wire, and welds welded body so that arc

between electrode wires and welded bodies
which are sent out may be maintained, or MAG welding apparatus.
And this apparatus is characterized by having control device for controlling supply apparatus so that supply speed of electrode wire is proportional to that pulse density while it controls electric-current supply apparatus to change periodically coarseness and minuteness of supply apparatus of electrode wire, electric-current supply apparatus to electrode wire, and pulse interval of electric current.
And this apparatus is suitably used, in order to implement MIG welding or the MAG welding method of Claim 1.

[0011]
[EMBODIMENT OF THE INVENTION] Next, Embodiment of this invention is demonstrated based on drawing.
FIG. 1 is apparatus block diagram for demonstrating principle of the MAG welding method of this invention.
Electrode wire 2 which coiling roll 1 wound is by supply apparatus 10 which has a pair of driving roller.
Weld zone supplies at a fixed rate which was adjusted.
Electric current of the form of a pulse from electric-current supply apparatus 11 is supplied to electrode wire 2 to supply, arc 6 is continuously formed in weld of welded body 5 of it.
Apparatus equipped with pulse motor which rotates, for example by pulse input, and driving roller connected with the output shaft as a supply apparatus 10 can be used.
Moreover, as an electric-current supply apparatus 11, welding-source apparatus usually used in this field can be used.
Electric current of speed of these supply apparatus 10 and the form of a pulse of electric-current supply apparatus 11 etc. is controlled by control device 12.
In addition, also in FIG. 1, gas-shield part is omitted for convenience and shown.

[0012] Control device 12 has electric-current pulse-control section 13, supply speed-control section 14, and timer apparatus 15.
Electric-current pulse-control section 13, pulse generating means to generate pulse-train signal which is two kinds of pulse interval inside, sparse or dense, change-over means which switch the coarseness and minuteness to timer apparatus 15 periodically with predetermined time interval, output means to output sparse or dense pulse-control signal switched by change-over means to electric-current supply apparatus 11 are included.
And electric-current supply apparatus 11 supplies electric current of pulse interval like FIG. 2 to electrode wire 2.
That is, electric current that period A with dense pulse interval and period B with sparse pulse interval are repeated alternately fixed period is supplied to electrode wire 2, according to electric current of each form of a pulse in Period A, five droplet occurs from electrode wire and enlarges molten-metal pool of weld zone.
According to electric current of each form of a pulse in Period B, three droplets

occur from electrode wire.
And molten-metal pool is enlarged by period A with high density of droplet spacing.
Molten-metal pool is reduced by period B with low droplet density.

[0013] They are comparison means by which supply speed-control section 14 compares said control signal from electric-current pulse-control section 13 with signal from speed detector 16 which detects speed of supply apparatus 10 in FIG. 1, output means to output supply speed control signal which fluctuates supply speed with signal of positive and/or negative from comparison means to supply apparatus 10 are included.
In addition, as a speed detector 16, rotation encoder, tachometer, etc. which were connected with output shaft of supply apparatus 10, for example can be used.

[0014] FIG. 3 is comparison figure of weld zone welded by the conventional MAG welding method when setting amplitude of electrode constant, and weld zone welded by the MAG welding method of this invention while setting heat gain of welding constant.
Although further explained in full detail in the Example mentioned later In this example, electrode is compared and weaving is carried out to width direction of weld zone in open-end department, it sets to right-and-left stop position and its vicinity by a diagram, pulse current of coarseness and minuteness is supplied in this invention, fixed pulse current was supplied by the conventional-type method.
In addition, welding electrode transfers at fixed speed in the direction of valley-bottom line of open end of welding also in stop position and weaving position on either side.
And when heat gain of method is fixed, since the average effective current is fixed, in conventional type, amount of supply of the molten metal is both uniform.
It sets to right-and-left both stop position and its vicinity in this invention to it, supply current and increase of the wire amount of supply, in intermediate position, average supply current and wire amount of supply become less.
As a result, at the time of each stop in the direction of this invention, melted area and melted depth increase.
Then, it sets to butt welding which carried out open end, welding width differs from welding state like bottom step of FIG. 3 by both the welding method.
And depth of penetration of welding and penetration width of welding are in this invention large, and weld zone reaches deeply in wall surface of open end.
On the other hand, formerly method may not be enough as penetration width and depth of penetration of welding.

[0015] Next, if method to carry out MAG welding using the above-mentioned apparatus is demonstrated, while setting output current of electric-current supply apparatus 11 value which becomes 1 pulse 1 droplet first, time interval of coarseness-and-minuteness period of current pulse is set up with

timer apparatus 15.
Apparatus is started by pushing start switch which is not illustrated, pulse-control signal of sparse or dense spacing is outputted to electric-current supply apparatus 11 with time interval set up from electric-current pulse-control section 13, it superimposes on base electric current fixed to electrode wire 2 as shown in FIG. 2, and electric current of the form of a pulse of sparse or dense spacing is periodically supplied by it.
On the other hand, supply speed-control section 14 outputs supply speed control signal corresponding to coarseness-and-minuteness pulse-control signal from electric-current pulse-control section 13 to supply apparatus 10 from the output means, supply apparatus 10 fluctuates supply speed of electrode wire 2 with the supply speed control signal.
And speed detector 16 detects supply speed of electrode wire 2, it is fed back to comparison means of electric-current pulse-control section 13.
Even when rattle exists in output shaft of result 10, for example, supply apparatus, etc., electrode wire 2 is supplied to weld zone at speed correctly proportional to the exhaustion speed.
Therefore, arc in weld zone is stabilized, uniform welding is continuable.

[0016] Thus, while supplying coarseness-and-minuteness pulse-like electric current to electrode wire 2, enlargement reduction of molten-metal pool is continuously repeated smoothly under stable arc by proportioning the amount of supplies at exhaustion speed, continuous uniform flaky beat can be formed in weld zone by high-efficiency, inhibiting dripping from molten-metal pool by it.

[0017]
[EXAMPLE 1] Next, example which carried out MAG welding according welding between terminal portions of metallic conduit to the method of this invention is shown using apparatus like FIG. 1.
Two pipes (material: STPG370) with aperture diameter of 300 mm (phi), a thickness of 10.3 mm, and a circumference of 1000 mm are provided as a metallic conduit, butt welding of between those terminal portions was carried out like FIG. 4.
At this time, width of 4 mm opened between troughs of comparison section, and it made open end 32.5°.
And electrode wire 2 uses diameter 1.2 mm of Z3312-YGW12 of JIS specification.
Item of pulse current supplied from electric-current supply apparatus 11 is as in Table 4.
That is, summit current of pulse is I_{max}=430A, between the peak hour is 2msec, base electric current is I_0=30A, base time = 4.8 to 16.3 msec.
Each pulse number at that time is 55Hz - 147Hz.
Moreover, the wire feed amount is 5.5 m/min - 2.75 m/min.
Effective value of each electric current is 153A-76A.

[0018] And let root pass be manual weld of TIG, it carried out so that remaining layer might be laped with MAG automatic welding by the method of this

invention.
That is, while repeating dense pulse region and sparse pulse region alternately, wire feed amount was changed in proportion to coarseness and minuteness of the pulse.
Setting conditions of the MAG welding
2nd pass is as Table 1, 3rd pass is as Table 2.
Based on experiment, the stability of welding and the rapid property of welding are considered and provided by these conditions.
Time until it finalizes butt welding was needed as shown in the result table 3 for 23 minutes.

[0019] Welding by the method of this invention (it is coarseness-and-minuteness existence to pulse period)
Root pass (single-pass eye) Manual weld (TIG welding)
Two pass eye (0°-360°)

[TABLE 1]

		溶接位置	
		A～D	E～H
密パルス域	周波数 Hz	147	114
	送り量 m/min	5.5	4.5
	時間 sec	0.1	0.3
疎パルス域	周波数 Hz	80	63
	送り量 m/min	3.5	3.0
	時間 sec	0.2	0.3
溶接速度	mm/min	175	100
肉盛量	mm	3.3	4.3
溶着量	g/min	37.0	29.8

[0020] 3 passing eye (0°-360°)

[TABLE 2]

		溶接位置		
		A～C	D～E	F～H
密パルス域	周波数 Hz 送り量 m/min 時間 sec	80 3.5 0.1	80 3.5 0.2	80 3.5
疎パルス域	周波数 Hz 送り量 m/min 時間 sec	55 2.75 0.2	61 2.9 0.2	80 3.5
溶接速度 肉盛量 溶着量	mm/min mm g/min	60 4.4 26.6	60 4.5 27.5	90 3.3 31.1

[0021]
[TABLE 3]

溶接時間		アーク時間	ヘッド戻り時間	+α（＊1）
2パス目	0°→360°	7分50秒	－	30秒
3パス目	360°→0°	14分40秒	－	－
		合 計	23分	

[(*1): +(alpha), crater-treatment and torch up-and-down time

[0022] Conditions used with all-position MAG welding

[TABLE 4]

パルス周波数	ピーク電流(A)	ピーク時間(msec)	ベース電流(A)	ベース時間(msec)	ワイヤ送り量(m/min)	実効電流値(A)
147	430	2.0	30	4.8	5.5	153
114	430	2.0	30	6.8	4.5	125
80	430	2.0	30	10.5	3.5	97
63	430	2.0	30	13.8	3.0	83
61	430	2.0	30	14.5	2.9	81
55	430	2.0	30	16.3	2.75	76

[0023] Next, automatic welding by the conventional MAG welding method was tried as Comparative Example.
The welding condition is as in Table 5.
As shown in Table 6, finalization time of welding required the result for 37 minutes and 30 seconds.

[0024] Comparative Example (pulse period regularity)
Root pass (1st pass manual weld)
2nd pass-4th pass

[TABLE 5]

	溶接位置	
	D～A	F～H
周波数 Hz	110	110
送り量 m/min	4.3	4.3
溶接速度 mm/min	100	100
肉盛量 mm/min	3.4	3.4
溶着量 g/min	21.5	21.5

[0025]
[TABLE 6]

溶接時間		アーク時間	ヘッド戻り時間	+α（＊1）
2パス目	180°→0°	5分	1分	30秒
	180°→360°	5分	1分	30秒
3パス目	180°→0°	5分	1分	30秒
	180°→360°	5分	1分	30秒
4パス目	180°→0°	5分	1分	30秒
	180°→360°	5分	1分	−
		合　計	37分30秒	

[(*1): +(alpha) crater-treatment and torch up-and-down time

[0026] Therefore, it turned out that the welding method of this invention is formerly rapidly cut with welding 39% compared with method.
Welding condition in conventional-type welding at this time makes root pass manual weld of TIG like the above, it carried out so that remaining layer might be made right and left half-circle every from undersurface of pipe with MAG automatic welding, respectively.
In addition, in the case of this conventional method, frequency and wire feed amount of pulse were set constant.
The welding condition is as in Table 5.
This welding condition considered the stability of welding, and the rapid property of welding based on experiment in the conventional-type welding method, and provided them in the optimal thing.

[0027] Moreover, this pulse frequency and wire rate of feed were set as the greatest value which is not while molten metal welds.
As a result, by the conventional-type welding method, molten-metal amount of supply from welding rod is 21 g/min.
Amount of supply carries out increase in 1/3 of the direction of the method of this invention, it turned out that welding operation can be performed rapidly.
Furthermore, when laminating molten metal to multiple layers, the welding operation can be performed continuously that what is sufficient is just to lap repeatedly in the same direction in this invention.
On the other hand, by the right-and-left distribution method, operation which returns electrode, and reset time for it are needed for lower end of pipe for every half-circle, many work hours were needed as a whole.

[0028]
[EXAMPLE 2] Next, comparative experiments of the welding method of this invention when carrying out weaving welding and the conventional-type welding method were carried out by welding condition of the same heat gain on flat surface.
That is, laminate board material of thickness 6 mm like FIG. 7, open end V is set to 18 mm at upper board material, the next condition comparative experiments were conducted.
It is referred to as maximum-value 480A of pulse current, base electric-current 50A, and maximum-value electric-current time 2msec, it is referred to as base electric-current time 2.8msec.
And by the method of this invention, it is considered as dense pulse frequency of 333Hz (effective-current 333A), and sparse pulse frequency of 87Hz (effective-current 125A), the average effective current is alternately set to 230A repeatedly both same time.
Former method, it was presupposed that pulse frequency 208Hz (effective-current 230A) is fixed.
As a result, in direction of the method of depending on this invention, formerly, the penetration width W of penetration width in method was 18 mm 22 mm.
Moreover, by the method of this invention, it melted into back side of lower metallic plate, and spot appeared.
However, by the former method, it did not occur.
It turned out that the method of this invention is excellent in penetration width and depth of penetration compared with the method of conventional type by that cause.
Both weaving width at this time transferred electrode to table shape with 10 mm and welding speed of 100 mm/min.

[0029]
[EXAMPLE 3] Since root pass was welded in said Example 1, Example which carried out MAG welding from root pass next is demonstrated.
That is, example which carried out MAG welding according welding between terminal portions of metallic conduit to the method of this invention is shown using apparatus like FIG. 1.
Two pipes (material: STPG370) with aperture diameter of 300 mm (phi), a thickness of 10.3 mm, and a circumference of 1000 mm are provided as a metallic conduit, butt welding of between those terminal portions was carried out like FIG. 4.
At this time, width of 1 mm opened between troughs of comparison section, and it made open end 30°.
And electrode wire 2 uses diameter 0.9 mm of Z3312-YGW12 of JIS specification.
Item of pulse current supplied from electric-current supply apparatus 11, summit current of pulse is I_{max}=430A, between the peak hour is 2msec, base electric current is I_0=30A, base time is 0.6-7.9msec.
Each pulse number at that time is 101Hz - 3807Hz.
Moreover, the wire feed amount is 4.0 m/min - 12.0 m/min.

Effective value of each electric current is 1313A-310A.

[0030] And it carried out so that it might lap with MAG automatic welding from root pass.
That is, while repeating dense pulse region and sparse pulse region alternately, wire feed amount was changed in proportion to coarseness and minuteness of the pulse.
Single-pass eye of setting conditions of the MAG welding is as Table 7, 2 passing eye being Table 8.
Based on experiment, the stability of welding and the rapid property of welding are considered and provided by these conditions.
Time until it finalizes butt welding was needed as shown in the result table 9 for 21 minutes.

[0031] Welding by the method of this invention (it is coarseness-and-minuteness existence to pulse period)
Root pass (single-pass eye)

[TABLE 7]

		溶接位置	
		A～D	E～H
密パルス域	周波数 Hz 送り量 m/min 時間 sec	380 12.0 0.5	345 11.0 0.2
疎パルス域	周波数 Hz 送り量 m/min 時間 sec	204 7.0 0.1	204 7.0 0.1
溶接速度 肉盛量 溶着量	mm/min mm g/min	250 5.8 55.7	250 5.6 51.6

[0032] Two pass eye (0°-360°)

[TABLE 8]

		溶接位置		
		A～C	D～E	F～H
密パルス域	周波数 Hz 送り量 m/min 時間 sec	189 6.5 0.5	189 6.5 0.7	189 6.5 0.5
疎パルス域	周波数 Hz 送り量 m/min 時間 sec	101 4.0 1.29	112 4.3 1.13	112 4.3 1.13
溶接速度 肉盛量 溶着量	mm/min mm g/min	60 4.8 23.5	60 5.1 25.7	90 4.8 24.9

[0033]
[TABLE 9]

溶接時間		アーク時間	ヘッド戻り時間	＋α（＊1）
1パス目	0°→360°	4分00秒	－	30秒
2パス目	360°→0°	16分40秒	－	－
		合 計	21分10秒	

[(*1): +(alpha) -- crater-treatment and torch up-and-down time]
[0034]
[ADVANTAGE OF THE INVENTION] It is MIG welding or the MAG welding method of Claim 1 as mentioned above, since coarseness and minuteness of that pulse interval is periodically changed as a value in which one droplet generates electric current for every pulse and it was made to proportion supply speed of electrode wire in this pulse density, while periodic enlargement reduction of molten-metal pool can be performed smoothly with stability and dripping from molten-metal pool is effectively inhibited by it, since welding current in area where pulse is dense, and wire amount of supply at that time can be increased, the amount of welding and melted depth of one time are increased.
Rapid welding and high welding of reliability are simultaneously securable.
Moreover, dripping of molten metal can prevent effectively.

Therefore, it becomes possible to lap and weld periphery of piping in the fixed direction, rapid welding can be performed.

[0035] Next, MIG welding or MAG welding apparatus of Claim 2 is equipped with supply apparatus of electrode wire, electric-current supply apparatus to electrode wire, and control device that controls supply apparatus so that supply speed is proportional to the pulse density while controlling electric-current supply apparatus to change periodically coarseness and minuteness of pulse interval of electric current, in order to implement MIG welding or the MAG welding method of Claim 1, it is used suitably.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1] Apparatus block diagram for demonstrating principle of the MAG welding method of this invention.

[FIG. 2] Figure showing periodic change of electric current of the form of a pulse supplied to electrode wire by electric-current supply apparatus in the MAG welding method of this invention.

[FIG. 3] Comparison figure of weld zone welded by the conventional MAG welding method when setting heat gain of welding constant, and weld zone welded by the MAG welding method of this invention.

[FIG. 4] Cross-sectional explanatory drawing of piping welded, respectively by the MAG welding method and the conventional MAG welding method of this invention.

[FIG. 5] Explanatory drawing of welding sequence by the MAG welding method of this invention.

[FIG. 6] Explanatory drawing of welding sequence by the MAG welding method of conventional type.

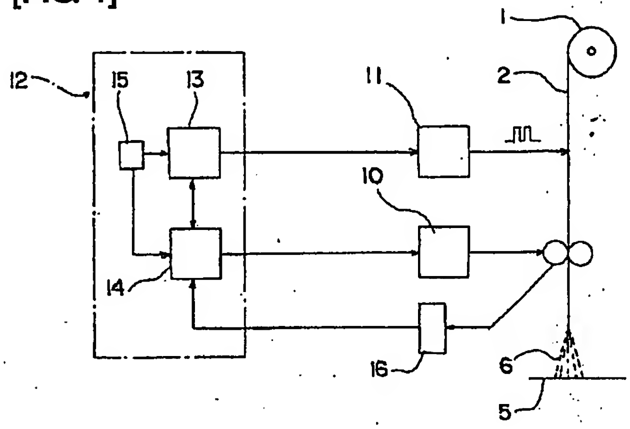
[FIG. 7] Cross-sectional explanatory drawing of object which welds flat surface, respectively by the MAG welding method and the conventional MAG welding method of this invention.

[FIG. 8] Apparatus block diagram for demonstrating principle of the conventional MAG welding method.

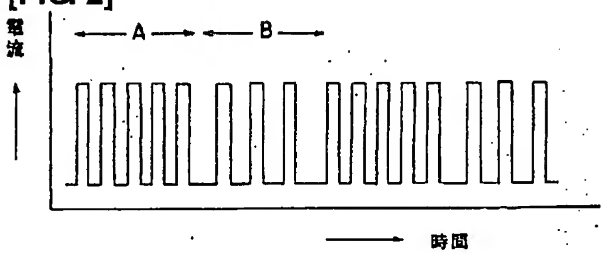
[DESCRIPTION OF SYMBOLS] 1 Coiling roll
2 Electrode wire
3 Supply apparatus
4 Electric-current supply apparatus
5 Welded body
6 Arc
7 Control device

10 Supply apparatus
11 Electric-current supply apparatus
12 Control device
13 Electric-current pulse-control section
14 Supply speed-control section
15 Timer apparatus
16 Speed detector

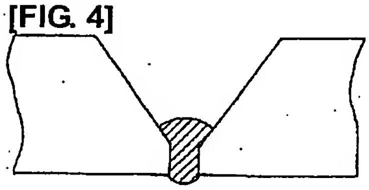
[FIG. 1]



[FIG. 2]

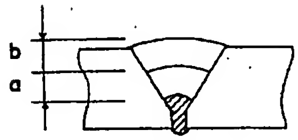


[FIG. 4]

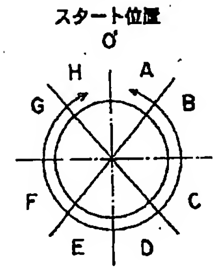


[FIG. 5]

(A)



(B)

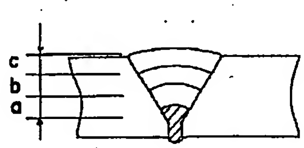


[FIG. 3]

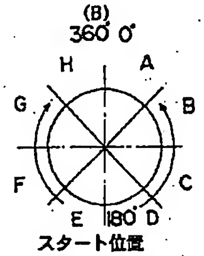
	従　来	本発明	
ビード巾	ビード巾 α ウィビング巾 左停止　右停止 ウィビング	ビード巾 β ウィビング巾 左停止　右停止 ウィビング	α＜β
溶込深さ	α α'	β β' 左停止　右停止	α'＜β'
開先き溶接部断面	電極	電極	

[FIG. 6]

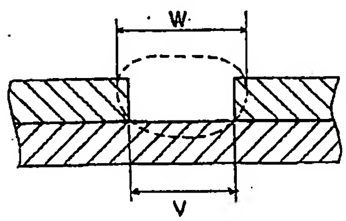
(A)



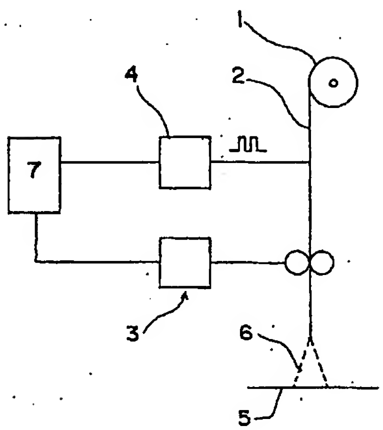
(B)



[FIG. 7]



[FIG. 8]



THOMSON DERWENT

DERWENT TERMS AND CONDITIONS